

FROM THE OBITUARY

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Wilhelm Cauer's personality was characterized by very estimable traits, rather than by voluble projection. With distinct modesty in his personal requirements, his chief interest was dedicated almost exclusively to his chosen field of circuit theory and its related mathematical disciplines. His love for a systematic approach to science and his strong sense of duty often led him to problems, the solutions of which to him appeared to be necessary for the consequent development of circuit theory, which produced no immediate rewards. With his uncompromisingly strict but somewhat dry oral or written presentation of such problems, he found at the beginning little interest or consideration. Typically, mathematicians found Cauer's articles mathematically of little interest. For electrical engineers there seemed to be little use for this work which, no doubt, was mathematically quite interesting.

Truly W. Cauer opened a new boundary field of mathematics and engineering for the understanding of which more engineering knowledge was necessary than could be assumed even from an applied mathematician, and more and a different kind of mathematics than could be presupposed from an electrical engineer. Therefore it is understandable that at first only a few colleagues and students properly appraised Cauer's work.

After some ten years of effort in constructing the systematic circuit theory he was able to place it in its proper perspective so that professional groups could recognize its broad outlines. As time went on, appreciation of his work grew and crossed national boundaries (e.g., R. Julia, 1935, *Sur la théorie des filtres de W. Cauer*, and others).

Today the respect of his former colleagues in many countries (with many of whom he enjoyed a mutually beneficial exchange of ideas) and the reverence of his former students (who owe so much to his example,

¹ AEU 1 (1947), 84.

his encouragement, and his ever ready assistance) will preserve and solace his memory.

To appraise W. Cauer's scientific achievement, let us consider the fundamental progress which he brought to circuit theory. Circuit theory means here the concept of frequency-dependent electrical networks consisting of inductors, capacitors, and resistors. While its elementary part, the analysis of given circuits, had been highly developed before Cauer, its progressive part, the synthesis of networks for prescribed requirements in frequency behavior, was still in its infancy. There were already, for some problems, very valuable partial solutions, especially for filters (K. W. Wagner, 1915, 1919, *Cascade Networks with Equal Sections*; G. A. Campbell and O. J. Zobel, *Cascade Networks with Different Sections*, and others). However, it was typical to start with specific circuits rather than general ones; therefore the results were empirical, accidental, and incomplete from a systematic standpoint. The question of *all* solutions of the technical problem and their comparison remained open. This question W. Cauer posed to himself. He showed that technical network problems can be solved systematically in terms of three main topics: realizability, equivalence, and interpolation (approximation). In detail:

Realizability—Which mathematical functions of frequency can be realized as the frequency characteristics of a two-terminal network, a two-terminal-pair network, etc., and how does one find a network associated with a realizable frequency characteristic?

Equivalence—How does one find from one network all others with the same frequency characteristic, i.e., all equivalent networks?

Interpolation—How can one approximate or interpolate best by means of the realizable functions the ideal mathematical requirements into which the prescribed technical problems of the desired network can be translated?

This approach, pioneered by Cauer, must have appeared very abstract and thorny to his contemporaries; especially since a certain knowledge of algebra, topology, and function theory is required and because even the fundamental questions of realizability and equivalence essentially had not yet been solved.

As the solution of these problems proceeded, especially through W. Cauer himself, but also by his colleagues and students, the described approach proved to be superior. This superiority rests on the fact that basically all possible networks compete as solutions of the circuit problem and one can select the best ones, in contrast to the earlier specific approaches which yielded only one or two solutions.

In addition to the concept of this daring and encompassing approach to network systems, we attribute to Cauer many basic contributions to its implementation; a series of original and generic inventions and the integration of most of the contemporary results, and last but not least the very

tedious and valuable development of the practically important results which he made available to the designer.

He was not privileged to see the basic questions of realizability and equivalence answered completely and thus to bring the structure of his systematic circuit theory to a preliminary conclusion. Perhaps W. Cauer will be honored best through attempts to continue the development of network theory in his spirit.